Coastal Engineering Technical Note

ELBLOC^{tm} REVETMENT UNIT - PRELIMINARY GUIDANCE

PURPOSE. To provide preliminary guidance for using the ELBLOC^{tm} revetment unit on coastal revetments.

BACKGROUND. A new, patented revetment unit, the ELBLOC^{tm} (U. S. Patent No. 5,176,466, Revetment Unit and Method for Protecting Shoreline or Waterway), has been developed at the U.S. Army Engineer Waterways Experiment Station's (WES's) Coastal Engineering Research Center (CERC). The ELBLOC was developed to meet a need for a highly stable revetment unit with a simple, easily moldable design. The revetment unit will protect shoreline or waterway embankments from erosion caused by waves or currents. It is L-shaped, has a low center of gravity for stability, maximizes area covered per unit weight, and is designed to be placed in a fitted, interlocking matrix which has sufficient porosity to allow drainage and prevent excessive water pressure under the units (Figure 1).

Model revetments formed from the units were tested in a WES laboratory wave flume using model units weighing approximately 0.3 lb with a specific gravity of 2.27. For the initial test, the model revetment was placed on a mound of crushed stone with a 1V:1.33H (37-deg) slope. The placement pattern is shown in Figure 2. Chain was placed along the edge of the revetment to simulate continuity of interlocking and prevent flume wall effects. Tests were conducted using short period waves, partly to simulate limited fetch conditions and partly because previous tests on other revetment units had indicated lower stability with shorter wave periods (McCartney and Ahrens 1975). Tests involved nonbreaking waves or surging breaker conditions and were run in 3-min bursts (Camfield, Hennington, and Reed 1993).

A second test series was conducted with the revetment units placed on a thin bedding layer of crushed stone laid over an impermeable slope. A 1V:1.33H slope was also used for the second test series with nonbreaking waves or surging breakers.

A third test series has since been conducted using revetment units placed on a layer of crushed stone over a filter cloth placed on a dense sand embankment. A 1V:1.5H slope was used for the third test series with strong surging breakers developing into plunging breakers on the revetment.

RESULTS OF PHYSICAL MODEL TESTS. For the first case (a 1V:1.33H slope on a permeable mound of crushed stone), the model revetment failed during the fifth burst of waves having a period of 1.5 sec and a height of 1 ft. Based on the Hudson equation, the units demonstrated a stability coefficient of approximately 175 at the wave height where the revetment failed. Failure occurred when the waves pulled out one or more units near the still-water line, followed by failure of the exposed underlayer.

For the second test condition, with an impermeable base, initial failure occurred at a wave height giving a stability coefficient of 97 (1.5- sec waves at a wave height of 0.82 ft). Again, wave action pulled out a block near the still-water line. Three additional 3-min bursts of waves were run at the same wave height with no additional loss of revetment units. Additional bursts of waves at a

slightly higher wave height caused some slumping and irregularities in the surface of the slope. However, armor unit coverage remained continuous with no further loss of units.

The third test series was run on a different test setup, using an existing 1V:1.5H slope to obtain results for plunging waves on the test revetment. Both spectral and monochromatic waves were used. Maximum wave conditions obtained were with 1.7-sec monochromatic waves having an incident height of 0.74 ft. Strong surging breakers developed into plunging breakers on the revetment as the reflected waves combined with the incident waves. Structural failure could not be obtained as a limit was reached for the wave gauges in place in the flume (the height of the wave trains for larger waves, including reflected wave effects, exceeding the height of the gauges). Tests were discontinued at a point where test conditions gave a Hudson stability coefficient equal to 62.

The stability coefficients obtained for these preliminary tests are significantly higher than stability coefficients for other types of flat revetment units tested to date. At present, based on the preliminary tests which have been conducted, the revetment unit appears to have a high potential for meeting Corps needs on revetment projects in shallower water.

RECOMMENDATIONS. Based on preliminary results, and various factors which can affect structural stability, CERC recommends using a stability coefficient of 15 for the ELBLOC™ revetment unit as interim guidance. It should be noted that stability can be affected by individual site conditions, which may cause effects such as wave focusing. Stability of a revetment is also highly dependent on proper design of the revetment toe, and transition areas along the structure such as elbows; changes in slope; and changes from one type of armoring to another. Potential toe problems are generally overcome by keying the revetment toe into the sea bottom, whereas overcoming potential transition problems is dependent on construction quality control for site-specific conditions.

Individual project testing, using actual site conditions, is highly recommended for obtaining final project guidance.

ADDITIONAL INFORMATION. For further information, contact Dr. Fred E. Camfield, U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center, Wave Dynamics Division, at (601) 634-2012, FAX (601) 634-3433, or Internet: f.camfield@cerc.wes.army.mil.

REFERENCES

Camfield, F. E., Hennington, L, and Reed, R. (1993). "New revetment unit developed," *The CERCular*, Vol CERC-93-4, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

McCartney, B. L., and Ahrens, J. P. (1975). "Stability of Gobi block revetment to wave attack," CERC TM-55, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

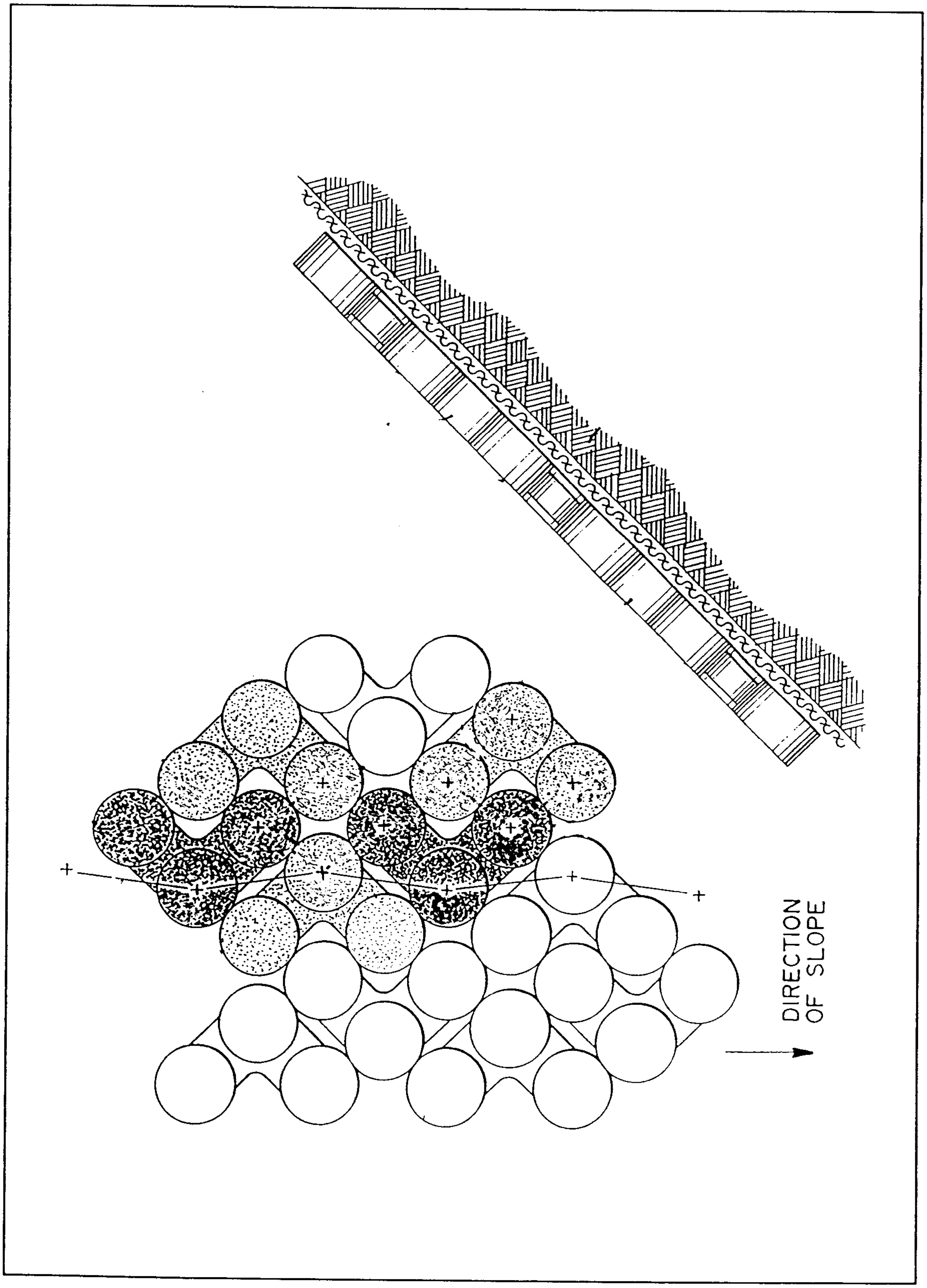

Figure 1. ELBLOC™ revetment units

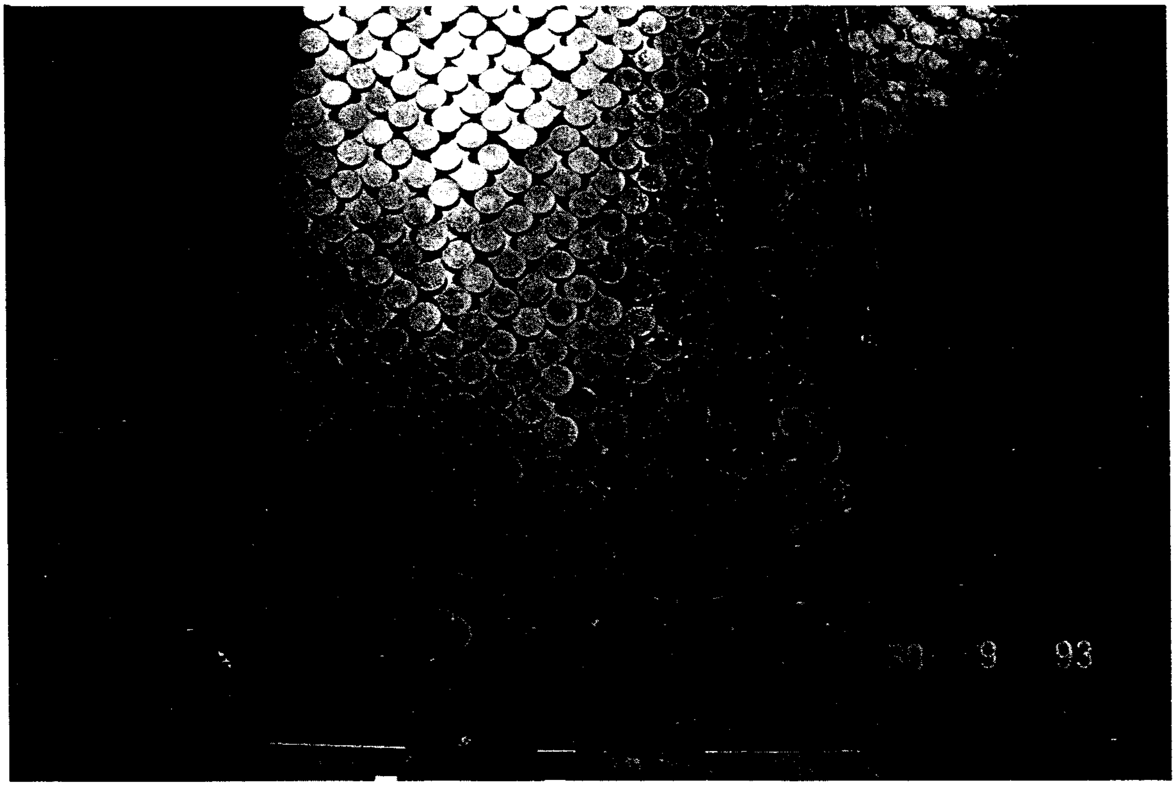

Figure 2. Test revetment